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## MIGRATIONS OF THE GRAYSQUIRREL (*SCIURUS CAROLINENSIS*)

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One of the most interesting animal phenomena recorded by the early naturalists was the migration, or rather the emigration, of the gray-squirrel.

A true migratory animal is one that makes a periodic change of range, which has a definite going, and a definite return. Thus the migration of birds, bats, and caribou are definite seasonal changes followed always by a return movement, but the migration of the gray-squirrel will I think be found in a different class.

In all the early natural histories this squirrel is called "migratory," and amazing accounts are given of its armies appearing to devastate the farms of whole regions. I have found no living man recently, who has seen one of these and can describe it, so must rest content with a compilation from two rambling accounts by the naturalists Kennicott, U. S. Pat. Off. Rept. for 1856 (1857) and Bachman (Quad. N. Amer., 1846). The paragraphs from each are followed by the initials "K." or "B."

The most interesting feature in the habits of this animal is the remarkable migration performed at times by large bodies of them. . . . Immense numbers congregate in autumn, and move off together, continuing their progress in the same general direction, whatever it may be [nearly all recorded moved easterly, one only south, and one north], not even turning aside for large streams. . . . They moved along rather leisurely, stopping to feed in the fields, and upon the abundant nuts and acorns of the forests. So far had they departed from their accustomed habits that they were seen on the prairie, four or five miles from any timber; but even there, as usual, they disliked to travel on the ground, and ran along the fences wherever it was possible. (K.)

The farmers in the Western wilds regard them with sensations which may be compared to the anxious apprehensions of the Eastern nations at the flight of the devouring locust. At such periods, which usually occur in autumn, the squirrels congregate in different districts of the far Northwest; and in irregular troops bend their way instinctively in an eastern direction. Mountains, cleared fields, the narrow bays of our lakes, or our broad rivers, present no unconquerable impediments. Onward they come, devouring on their way everything that is suited to their taste, laying waste the corn and wheat-fields of the farmer; and as their numbers are thinned by the gun, the dog, and the club, others fall in and fill up the ranks, till they occasion infinite mischief, and call forth more than empty threats of vengeance. (B.)

Ordinarily averse to entering the water, they now take to it boldly, and though swimming with difficulty, manage to cross broad rivers, like the Niagara and the Ohio, though many are drowned in the attempt. . . .

Sometimes, when on these migrations, especially after crossing rivers, the squirrels become so fatigued as to be easily captured, and thousands are then killed by boys armed merely with sticks and stones. I learn from Dr. John A. Kennicott that, during one of these migrations, innumerable squirrels swam across the river Niagara, and landed near Buffalo, New York, in such a state of exhaustion that the boys caught them in their hands, or knocked them from the fences and bushes with poles. (K.)

They swam the Hudson in various places between Waterford and Saratoga; those which we observed crossing the river were swimming deep and awkwardly, their bodies and tails wholly submerged; several that had been drowned were carried downwards by the stream, and those which were so fortunate as to reach the opposite bank were so wet and fatigued, that the boys stationed there with clubs found no difficulty in securing them alive or in killing them. Their migrations on that occasion did not, as far as we could learn, extend farther eastward than the mountains of Vermont; many remained in the county of Rensselaer, and it was remarked that for several years afterwards squirrels were far more numerous there than before. It is doubtful whether any ever return to the west, as, finding forests and food suited to their taste and habits, they take up their permanent residence in their newly explored country, where they remain and propagate their species, until they are gradually thinned off by the increase of inhabitants, new clearings, and the dexterity of the sportsmen around them. (B.)

#### AFTER THE TREK

After one of these grand migrations, very few of the species are found in the localities from which they have moved, and these, as if alarmed at the unusual solitude, are silent and shy. They rapidly increase in numbers, however, and, in a few years, are as abundant as before. I am not aware that they ever migrate except when exceedingly abundant. Of these immense hordes, but few probably survive. No sudden increase in their numbers was heard of in Southern Wisconsin after the several migrations from Northern Illinois. Many are drowned in attempting to cross streams as has been stated; not a few are destroyed by man; some die from utter exhaustion; and, when thus forced to travel, in an unnatural manner, upon the ground, they fall an easy prey to rapacious birds and mammals, all of which feast when the squirrels migrate. (K.)

These migrations are now a thing of the past, so that we can but piece together the accounts of the earlier naturalists, in seeking to explain such movements of the squirrel population. There are not many of these records, and those that exist are commonly deficient in not stating the direction or extent of the migration. The earliest I find is in Kalm's "Travels," p. 316. He speaks of a squirrel migration from the mountains to the lowlands of eastern Pennsylvania in 1747.

The best observations are by Dr. P. R. Hoy of Racine, Wisconsin. He witnessed a great migration of squirrels from Wisconsin, southwest, for four weeks in the early autumn of 1842, and again in 1847, 1852, and 1857.

Dr. S. P. Hildreth (Pioneer History of the Ohio Valley), 1848, quotes from the manuscript of Col. James Baker, of the graysquirrel "coming in millions from the north to the south, destroying whole fields of corn in a few days." (Mam. Ohio, H. W. Brayton, 1882.)

Doctor Bachman states that in the autumn of 1808 or 1809 great hordes came from the west into northern New York and Vermont; and of yet another migration in 1819 on the Ohio, 100 miles below Cincinnati, when for about 130 miles he saw "large numbers of Squirrels swimming across the river" "strewed as it were on the surface of the water." This is the only available note that indicates the width of the migrating army.

Robert Kennicott records a migration from Canada across the Niagara River into western New York. According to the Bay City Tribune (Michigan) February 17, 1907, there was a great squirrel migration there in 1866.

A careful review of the evidence makes it very clear that these movements of the squirrels were not in any true sense migrations. That is, they were not seasonal or annual or periodic or balanced by a return movement of any kind. They were simply wholesale movements of a huge population from one region to another. Judging from numerous parallel cases, such a movement could arise only from one of five causes: Flood, fire, famine, pests or over-population. There is no evidence for the first or second; as to famine, Kennicott, who has the most complete and detailed observations of all, makes a point of it that they are not driven forth by want of food, for the animals are fat at the time and the regions they leave still abound with food. Furthermore, the season when they go forth is early autumn, the time of the greatest food abundance. The migration that Merriam reports in the Adirondacks and that Jackson describes in Wisconsin are very small affairs and in all respects of a different class.

It is possible that the vast multiplication of nesting places may have resulted in an insupportable increase of parasites in the shelters so that the nests had become untenable. But of this there are only two shreds of evidence at hand. One, the known fact, that overcrowded squirrel nests breed abundant parasites; second the squirrels are comparatively scarce after the army has gone. Thus the evidence is far from conclusive.

We have, then, the last cause to consider—over-population. The army has always come from a land of plenty—a place of ideal squirrel conditions—at a time when they seemed at their best, and further, the time of migration is always just as the broods of the year are full grown. No one has ever recorded a squirrel migrating from a land when they were few or moderate in numbers, always from a place where they overabounded. No one has witnessed one of these treks since the squirrels became comparatively scarce.

This explanation is paralleled by the known causes that send the Scandinavian lemming and the African springbok millions, out of their country and on, till they meet their end; and last, probably most exactly, *by the swarming of bees*; the sallying forth of the new brood to seek a new home, for there is not room in their birthplace. In a word then, the graysquirrel swarms as the bees swarm; this explains their marching armies. But the dwindling of their numbers has put an end to their emigrations. I have not yet heard of one since 1866.

#### NUMBERS

How are we to form any idea of their numbers in primitive times when the whole land was one big harvest field of nuts for their chief benefit?

The early naturalists seemed satisfied to describe the squirrel hordes as “astounding,” “immense,” “myriads,” “incredible,” or “unbelievable,” and we rejoice that Kennicott and others of more exact mind were born in time to make a more satisfactory record. Kalm relates (*Travels*, p. 320) that in the year 1747 the State of Pennsylvania paid bounties for the killing of 640,000 squirrels. In “*The Hunter’s Feast*,” published about 1840 (p. 163) is an account of an all-week Kentucky squirrel hunt in which the sides with 6 guns on each, killed respectively 5000 and 4780 squirrels.

Robert Monro writes in 1804 of squirrel hunts in western New York in which upwards of 2000 squirrels have sometimes been killed in one day. (Merriam, *Mam. Adirondacks*, p. 229.)

Dr. P. R. Hoy knew of "an Ohio hunter that killed 160 in one day in an 'off season.' In parts of Michigan, Illinois, Southern Wisconsin and Indiana, they are no less numerous." (Quad. Ill., 1857, p. 63.) Doctor Bachman saw 130 miles of the Ohio "strewed" with them in 1819; an old settler of Bay City, Michigan, records (Bay City Tribune, 17 Feb., 1907) that in the migration of 1866, one of the last, he counted 1400 squirrels while driving 2 miles.

Finally if we recall, as the third dimension, that Doctor Hoy found it took a month for the army to pass, we have some basis for calculation. Allowing that the squirrels travelled 5 miles a day, we have an army, 130 miles wide, 150 miles long, in which as many as 1400 might be seen by the road within 2 miles. That road must have been through the woods, therefore 20 yards on each side would be the limit of view. This would mean 30,000 to the square mile, or 450,000,000 squirrels in the dimensions recorded. Such numbers seem incredible, and yet that is what the old naturalists said they were, *unbelievable, incredible, etc.*

Even if we largely discount these figures, we must remember that there are many such armies and that only a small section of the range was represented; not more than one-fortieth of it.

A corroboration of these high rates is found in a recent occurrence. The graysquirrels in Central Park, New York, became over-many. It was decided to thin them out; 300 were shot in one week without making much perceptible difference. There were at least twice as many left in the woods which cover nearly half of this 800-acre park. That is, there were over 1000 to the 300 acres of timber.

In my recollection of a squirrel woods in Ontario, 1887, the numbers in Central Park are not to be compared to those in the northern woods. They were at least three times as numerous in the latter and yet we knew that there were about 3 to the acre in the park.

In western Texas there is, according to the Biological Survey, a prairiedog town of 25,000 square miles, with an estimated population of 400,000,000 or 25 to the acre. This is probably a higher rate than the graysquirrel ever attained to, but it shows the possibilities even with an animal of more than double the size.

The range of the graysquirrel is about 1,000,000 square miles; allowing, that in half of this, they were scarce, and that in the teeming parts they were no more numerous than in Central Park, we have an estimate of 1,000,000,000 as the lowest guess at the primitive number that one can arrive at. But we have noted above one of several armies that totalled nearly half a billion. Who then can doubt, in view of this,

that the graysquirrel population in the palmy days of 1800 may easily have numbered several billions.

These great movements have never been clearly observed. The only way at present possible to fill the gap is by collecting the testimony of eyewitnesses—the old-timers who are passing away—for I have little faith in any great emigration since 1870. That was about the latest date at which primitive conditions continued anywhere in the northern Mississippi Valley.

Will not our young naturalists render service now by interviewing all available old-timers—the men who joined in the squirrel hunts of the '60's—and make as full a record as possible of the time, place, extent, direction, etc., of every emigration that can be traced, together with facts that bear upon its cause and results or that in any way offer interesting light?

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## AN APPARENT EFFECT OF WINTER INACTIVITY UPON DISTRIBUTION OF MAMMALS

BY HARTLEY H. T. JACKSON

### INTRODUCTION

It was the writer's pleasure during the past summer (1919) to spend a few weeks investigating the terrestrial vertebrate fauna of the Apostle Islands, Wisconsin, as a part of the general study of the land vertebrates of the state now being undertaken by the United States Biological Survey, the Wisconsin Geological and Natural History Survey coöperating. My first visit to the islands was from June 22 to 26, when all the time was spent on Madeline Island. I again visited the islands July 3 to 24, accompanied by Mr. Harry H. Sheldon and Mr. Arthur J. Poole who assisted in the work. On this second visit careful investigations were made on Madeline Island, July 3 and 4, 12 to 15, 20 and 21; Outer Island, July 5 to 11; Presque Isle or Stockton Island, July 15 and 16; Gull Island, July 18; Little Manitou Island or Gull Rock, July 18; Michigan Island, July 18; and Sand Island, July 23. Observations of a more or less superficial nature were also made on other islands, but physiographical conditions were such that the more intensive work on the islands selected undoubtedly gave us a fairly accurate idea of the mammalian fauna of the islands as a whole. Mr. Sheldon and Mr. Poole returned to the islands September 4 and remained until